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ABSTRACT

An investigation was made of the effects of age and sex on preschool children's discrimination of intensity in musical contexts. Subjects included 92 children ranging in age from 37 to 70 months. A total of 47 females and 45 males participated in the study. To determine preschoolers' loudness discrimination abilities, a new test was designed: The Loudness Discrimination Test (LDT). This instrument utilized a 12-note melody based on a Jamaican folk song rather than pure tones or white noise. The LDT presented the stimulus melody at four intensity levels in discrimination comparisons (50 db, 60 db, 70 db, and 80 db corresponding to the musical dynamics of p, mf, f, and ff). To provide a comparison of the span of the dynamic range, two additional dynamic levels (55 db and 75 db) were included on the test tape. Whereas no significant interactions between age and sex factors were found, significant differences associated with age were found across all age groups, with younger age groups scoring lower than older age groups. Progressive, significant differences across age were noted for both loud-soft and soft-loud stimulus presentation orders. Improvement in scores occurred across all three age groups for the loud-soft presentation order. With regard to type of judgment required of subjects, judgments of "louder" produced higher mean scores within all age groups than did judgments of "softer." Age also was found to be a significant factor in the analysis of data concerning single and varied task types. (RH)

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# A Study of Musical Loudness Discrimination of Three- To Five-Year-Old Children

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A Study of Musical Loudness Discrimination
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Children

Perception and discrimination of intensity in music is an important listening skill. Gradations of sound intensity, reflected psychologically as perception of loudness and softness, add variety and contrast to musical sound and, in combination with other musical elements, contribute to our interpretation of musical mood and organization.

The ability to perceive, discriminate, and make relative judgments of musical sound intensity is a skill which seemingly appears early in the musical development of the child. Eisenberg (1976) has noted that "the mechanisms for processing intensity may be operational at birth, and have their roots in preadapted mechanisms stemming from the history of the species" (Shuter-Dyson & Gabriel, 1981, p. 103). According to Williams, Sievers, and Hattwick (1932), "the concept of relative loudness has become stabilized in practically all normal children by the time they are four years of age, in many cases even younger" (p. 17). Bond & Stevens (1969) found that four- and five-year -old children respond similarly to adults in cross-modality tasks when asked to match brightness of a light to the loudness of a sound.

Similarly, in reseach with six- to eight-year-olds, Riley, McKee, Bell, and Schwartz (1964) revealed that children tend to perceive intensities as having relative properties rather than absolute properties, with children having difficulty in loudness discrimination tasks when judgment of specific, absolute intensities is required. These researchers found that it is easier for children to learn an auditory amplitude discrimination than a frequency discrimination (McKee & Riley, 1962), that learned amplitude relationships are generalized to new situations more often than frequency relationships (McKee & Riley, 1963), and that children can arrange stimuli of different

amplitude in order from weak to intense more readily than they can arrange different frequencies from low to high (Riley, McKee, & Hadley, 1964).

From the results of these studies, it would appear "that by age four, children can make accurate judgments concerning relative loudness, and that for first grade children, this kind of discrimination is very easy indeed" (Zimmerman, 1971, p. 10). The results also suggest that loudness perception may develop without formal training due, in part, to experience that children have in applying verbal labels correctly to loud and soft environmental sounds: "Unlike the terms high and low, which are not learned casually in everyday experiences with sound, the terms loud and soft are early additions to children's vocabularies" (Zimmerman, 1971, p. 10).

However, recent research by Carter, Ricker, and Corsini (1972) suggests that the development of loudness discrimination and judgment skills of young children may not be so simple. Their study with three- to five- year-old children revealed that the development of "louder" relationship judgments of auditory intensities may develop at a different rate than "softer" relationship judgments. They found no significant change in accuracy in "louder" judgments across the three ages from three to five years; three-year-olds were as accurate on "louder" judgments as five-year-olds. Each successive age group, however, was more accurate in choosing the softer of two sounds. The study also disclosed that the order of sound presentation may affect children's responses: the more intense-less intense order produced significantly greater accuracy in three-year-old's responses, while all age groups showed progressive improvement in accuracy for the less intense-more intense order. Study findings also suggested that specific intensity levels may affect accuracy of young children's discrimination responses. In the study, three- and four-year-old children performed poorly when both tones of a pair of sounds were low intensity

sounds; five-year old children however performed equally well on all intensity levels investigated.

Carter, Ricker, and Corsini concluded that their results corroborated findings in other perceptual dimensions:

> Dimensions which are easily characterized as differing in magnitude, such as number, space, length, and sound intensity (stimuli that differ quantitatively rather than qualitatively), provide different tasks, depending on how the relationship between any two stimuli in the dimension is expressed. . . . The magnitude phenonmenon . . . appears to be a genuine property of the verbal-relational thinking in the preoperational child. (p. 4)

The majority of the above studies used pairs of single tones as discrimination task stimuli, ranging from the use of pure tones to white noise. Preschool children rarely, if ever, are required to make musical discriminative judgment of pure tones, white noise, or even isolated, single tones. Rather loudness discrimination by young children occurs most frequently in multi-dimensional musical selections.

Several questions consequently arise: (a) Will young children's discrimination of sound intensity also vary with age when more musical stimuli are used; (b) will their discrimination vary with age as a result of the stimulus presentation orders and intensity levels used and as a result of the type of judgment they are required to make (i.e., "louder" or "softer")?

In addition, the Carter, Ricker, and Corsinii study presented discrimination tasks in a fashion which required subjects to remember both "louder" and "softer" judgment labels over all the items presented. Do subjects' intensity discrimination responses vary with age when they only

have to remember one judgment label at a time and when they must remember both judgment labels, switching back and forth between the two labels over many discrimination tasks?

Finally, none of the above studies investigated differences in intensity discrimination resulting from sex differences. The present study sought to clarify these issues.

## Purpose

The purpose of this study therefore was to investigate the effects of age and sex on preschool children's discrimination of intensity in musical contexts. Specifically the study sought to answer the following research questions:

1. Is there a significant interaction between the factors of age and sex as reflected through loudness discrimination scores of preschool children?

2. Are there significant differences across age and sex groups in preschool children's loudness discrimination?

3. Do significant differences across age and sex groups exist in preschool children's loudness discrimination as a result of (a) the presentation order of the intensity of the musical stimulus, (b) the intensity level of the stimulus, (c) the type of judgment required, and (d) the type of discrimination task required?

## Procedures

To determine the loudness discrimination abilities of preschool children, a test was needed which measured the variables in question. On examination of the literature, no test was found which answered all the questions raised; therefore, the authors designed their own test.

The Test Tape

The Loudness Discrimination Test (LDT) was designed to utilize a musical stimulus rather than pure tones or white noise. To accomplish this, a twelve-note melody based on a Jamaican folk song was chosen for the test; this melody was built on a five-tone major scale and descending major and minor thirds. The melody was performed on piano and recorded using a Tandberg 10X quarter-track tape recorder and two AKG 222D microphones. The recording was made at 7½ ips.

After the original stimulus was recorded, it was processed at the Acoustics Laboratory of The Pennsylvania State University Applied Research Center. The original sound signal output was varied and recorded at different, accurately measured sound pressure levels. The reference value for all db measurements was 20 micro-newtons per square meter.

Because individual tones of a melody normally vary in intensity level, a Nicolet UA-500 spectrum analyzer was used to analyze the variety of dynamics of the stimulus melody, providing an average signal output which then could be subjected to a variety of db manipulations. The db manipulations of the stimulus then were generated through a General Radio Decade Attenuator, type 1450, and recorded on a TEAC Model 3340 quarter-track stereo tape recorder.

Upon completion of the tape, a check was made of the test using a Sony TC 360 quarter-track stereo tape recorder on which the test would be administered to the subjects. The sound levels were confirmed using the following Bruel and Kjaer Instruments: (a) a precision Sound Level Meter type 2209, (b) a one-inch condenser microphone type 4145, and (c) a Pistonphone Calibrator type 4220.

The intention of the authors was to determine loudness discriminations in a musical context spanning the range of practical musical dynamics.

The LDT presented the stimulus melody at four intensity levels in the discrimination comparisons (50 db, 60 db, 70 db, 80 db corresponding to the musical dynamics of p, mf, f, and ff) (Lundin, 1967, p. 41). It also was felt that a comparison of the span of the dynamic range might yield some useful information. Hence, two additional dynamic levels (55 db and 75 db) were included on the test tape.

The actual comparisons in the test included 50 db and 60 db (soft level), 60 db and 70 db (medium level), 70 db and 80 db (loud level), and 55 db and 75 db (range span level). The test also included items in two different presentation orders: some items in which the first melody of the stimulus pair was played louder and some items in which the first melody was played softer. The eight possible combinations of four intensity levels and two presentation orders then were assigned randomly to comprise a thirty-two item test in three subtests.

The eight combinations of dynamic levels and presentation orders were assigned randomly to one subtest which asked the question "Which sound is louder?". Another subtest was composed of eight randomly assigned items in which the question "Which sound is softer?" was asked. A third subtest, consisting of sixteen items, used randomly assigned dynamic levels and randomly assigned questions of louder and softer. Table 1 shows the order of the test and subtests as it appeared on the test tape.

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Insert Table 1

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The format of the tape included playing the stimulus melody once at a medium dynamic range (60 db) from both speakers of the recorder. This served as an example to familiarize the subjects with the melody that they would hear throughout the test. Next, in order to explain that different

dynamic levels were to be heard, the stimulus was played first in the left speaker at 50 db and then at 80 db in the right speaker. This served as a second example item; this comparison was chosen since it did not exist in the test itself. For the actual test items, the first dynamic level was presented in the left speaker, and the second dynamic level was presented in the right speaker throughout the test.

One second was selected as pause time between the two presentations of the melodic stimulus in each item. A six second silence occurred between each test item. Between the three subtests, fifteen seconds of silence was maintained.

Testing Procedures

The physical set-up of the testing room included a chair, on which the subjects sat, and the two speakers of the tape recorder used in the test. The chair and two speakers formed an equilateral triangle with a total distance of three feet (36 inches) on each side. To insure that the subject heard the most equal and maximum sound from both speakers, it was necessary that the subject look straight ahead during the test. To achieve this, a "Smiley" face was positioned directly in front of the chair equidistant between the two speakers and at eye level with the subject. Subjects were instructed to look at "Smiley" as they listened to the test items. The investigator sat behind the subject and operated the sound equipment.

Each subject entered the quiet testing room individually and was familiarized with the surroundings before the actual testing procedure began. The testing procedure began with an attempt to determine whether the subject had acquired the concepts and verbal labels of loud and soft; the tester requested that each subject play a loud sound on a drum and then play a soft sound on the drum. Then the tester played a sound on

the drum and asked the subject to play a sound that was louder; this procedure was repeated, and a softer sound was requested.

After it had been determined that the subject understood the terminology required, the main test began. Because of the ages of the subjects, a gaming format was felt to be an appropriate means of holding the children on task to obtain valid data. The subject was instructed to look at the "Smiley" face as he listened; the taped examples were begun; and the tester prompted the students by using the "Smiley" as the initiator of the game. At the beginning of each subtest, the tester explained the "rules of Smiley's game." The subjects were instructed to listen to the melodies presented in both speakers and then to touch or point to the speaker which they chose. The tester recorded all responses on an individual score sheet while the subject continued the test.

Subjects

The subjects included ninety-two children ranging in age from thirty-seven to seventy months. The breakdown by ages included twenty-seven three-year-olds, thirty-four four-year-olds, and thirty-one five-year-olds. The subjects attended four preschools--one church-related school, a Montessori school, one kindergarten, and a day-care center. There were forty-seven females and forty-five males in the sample.

Scoring the Test

To answer the questions posed in the study, the test was scored in several ways to produce eleven separate scores for each subject. First, a Total Test score was obtained by totalling all correct responses from the thirty-two item LDT. To answer the question dealing with presentation order, the test was subdivided, producing two Presentation Order scores--one for those items in which the first stimulus melody was loud

and a second score for those items in which the soft stimulus melody was played first (each Presentation Order score could range from zero to sixteen points).

To determine if discrimination differences occurred at different dynamic levels, four Intensity Level scores (each ranging from zero to eight points) were calculated: (a) one score for those items which used the 50-60 db range (soft), (b) one for items in the 60-70 db range (medium), (c) one for items in the 70-80 db range (loud), and (d) one for those items which spanned the range spectrum (55-75 db).

It was felt that the children might show response differences when asked to make a "louder" judgment and when asked to make a "softer" judgment of two melodies. Consequently, the thirty-two item LDT was rescored to produce two Judgment Type scores: one score was composed of all items in which the subjects answered the question "Which sound is louder?"; a second Judgment Type score resulted from those items which asked for the softer stimuli.

Finally, to determine whether differences occurred when subjects were involved in a one concept discrimination task and when they were presented with a varied task, the LDT was rescored to produce two Task Type scores: (a) the sixteen items from Subtests 1 and 2 which required a single task response were scored to yield the Single Task Type score; (b) Subtest 3, which required subjects to switch louder and softer concepts and terminology back and forth, was scored to produce a Varied Task Type score.

Reliability of the Test

The reliability for the LDT was found by applying the Kuder-Richardson Formula 21 to the subjects' Total Test scores. Through this procedure, a reliability coefficient of .85 was established for the test.

## Results

A two-way fixed factor design of the study enabled the investigation of the effect of (a) age factors across three levels, (b) sex factors across two levels, and (c) the interaction of the two factors on the loudness discrimination variables measured. Data collected from the ninety-two subjects resulted in an unbalanced design of unequal, disproportionate cell size. Consequently, separate three-way least squares analyses of variance were performed on the collected data--one analysis for each of the eleven LDT scores collected for each subject.

In each analysis, least squares means were computed for each main effect and interactive effect that resulted from the two-way design. Least squares means for unbalanced designs are "estimates of the class or subclass arithmetic means that would be expected had equal subclass numbers been available" (Goodnight & Harvey, 1978, p. 8).

The General Linear Model (GLM) procedure of the Statistical Analysis System (SAS) was used to compute each analysis of variance. The GLM procedure uses the least squares principle to fit linear models and performs analysis of variance for unbalanced data (Helwig & Council, 1979, p. 245). Significant differences among groups disclosed by each analysis were identified by t-test comparisons among the least squares means of appropriate groups.

### Total Test Score Analysis

To answer the first two research questions, the above procedures were applied to the total LDT scores of the subjects. Table 2 reports the computed least squares means and standard errors of the means for the main effects of age and sex for the Total Test scores.

Insert Table 2

These mean scores reflect that the majority of subjects regardless of age or sex performed well on the test. Three-year-olds' scores ranged from 11 to 32 points on the test, with the three-year-old group mean of 23.99 reflecting an average degree of accuracy of 75 percent on the test. Four-year-olds' scores, ranging from 16 to 32 points with a group mean of 28.08, were indicative of 88 percent accuracy. Five-year-olds scored in the range from 27 to 32 points, with a group mean of 30.64 indicating 96 percent accuracy.

Male subjects' scores ranged from 17 to 32 points with a group mean of 26.96 designating 84 percent accuracy. Females scored in a wider range from 11 to 32 points; their group mean of 27.19 indicated an average accuracy of 85 percent.

The results of the analysis of variance of Total Test data are reported in Table 3. The analysis revealed no significant interactions among age and sex on Total Test scores; consequently, an examination of the main effects results was appropriate. Although females scored slightly higher on the test than males, the analysis revealed that no significant differences existed between the two sex groups on loudness discrimination. However, significant differences were found for the main effect of age ($F$-ratio of 17.86, $p < .0001$).

Insert Table 3

Comparisons of the least squares means of the three age groups indicated that progressive improvement in loudness discrimination is evident across the ages from three to five years: the three-year-olds scored significantly lower than the four-year-olds ($p < .0003$) and the five-year-olds ($p < .0001$) on the LDT. In addition, the four-year-old group's scores were significantly lower than the five-year-old group's scores ($p < .02$). These results indicated that, while all age groups performed well on the test, significant differences in scores did result from the effect of age.

To determine whether differences in loudness discrimination scores resulted from presentation order or intensity level of the melodic stimulus or the type of judgment and task required of the subjects, least squares analyses of variance procedures also were applied to Presentation Order (PO), Intensity Level (IL), Judgment Type (JT), and Task Type (TT) data collected from the subjects. Tables 4 through 17 report the results of these ten analyses.

Presentation Order Analyses

Table 4 reports the least squares means and standard errors of the means (by sex and age groups) for each of the two presentation orders (PO LOUD-SOFT and PO SOFT-LOUD), while Tables 5 and 6 present the analyses of variance comparisons of PO LOUD-SOFT and PO SOFT-LOUD scores respectively.

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Insert Tables 4 - 6

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The two analyses of variance disclosed no significant interactions between the factors of age and sex and no significant differences between sex groups for either of the presentation orders. However, significant differences across age were found for both PO LOUD-SOFT ($F$-ratio = 13.51, $p < .0001$) and PO SOFT-LOUD ($F$-ratio = 11.60, $p < .0001$).

Comparisons of the least squares means of the three age groups for PO LOUD-SOFT data indicated progressive improvement across age: significant differences in discrimination accuracy occurred between three- and four-year-olds ($p < .003$), three- and five-year-olds ($p < .0001$), and four- and five-year-olds ($p < .02$) when the pair of stimulus melodies was presented in a more intense-less intense order. For the less intense-more intense presentation order, discrimination differences were significant between three- and four-year-olds ($p < .002$) and three- and five-year-olds ($p < .0001$). The four-year-olds' and five-year-olds' scores were not significantly different.

Intensity Level Analyses

The least squares means and standard errors of the means (by sex and age groups) for each of the four intensity levels measured (IL-SOFT RANGE, IL-MEDIUM RANGE, IL-LOUD RANGE, IL-RANGE SPAN) are presented in Table 7. Mean scores increased within each age level as intensity level increased from less intense (50 to 60 db range) to more intense (70 to 80 db range). The span of the intensity range (IL-RANGE SPAN, 55 to 75 db range) produced the highest mean scores within each age and sex group, suggesting that IL-RANGE SPAN was the easiest of the intensity level pairs for the subjects to discriminate.

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Insert Table 7

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Results of the analyses of variance on IL-SOFT RANGE, IL-MEDIUM RANGE, IL-LOUD RANGE, and IL-RANGE SPAN scores are reported in Tables 8 through 11 respectively. No significant interactions between age and sex factors were found in any of the analyses. A difference between sex groups

($F$-ratio = 4.06, $p < .05$) was noted only on IL-LOUD RANGE data (see Table 10). Examination of the sex group means indicated that the males scored significantly higher than females on items in the high intensity range level (70 to 80 db range).

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Insert Tables 8 - 11

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Differences across age also were found. On all four intensity level ranges, three-year-olds scored significantly lower than both the four-year-olds ($p < .007$ for IL-SOFT RANGE, $< .002$ for IL-MEDIUM RANGE, and $< .001$ for both IL-LOUD RANGE and IL_RANGE SPAN) and the five-year-olds ($p < .0001$ for all intensity level ranges). The five-year-old subjects performed more accurately than the four-year-old subjects on IL-MEDIUM RANGE items ($p < .02$) and on IL-LOUD RANGE items ($p < .03$). No significant differences in discrimination were found between the two older groups on either IL-SOFT RANGE or IL-RANGE SPAN mean scores.

Judgment Type Analyses

Subjects received separate scores for test items requiring a judgment of "louder" (JT-LOUDER) and those items requiring a judgment of "softer" (JT-SOFTER). Table 12 reports the least squares means and standard errors of the means (by sex and age groups) for data from each of the two judgment types. An examination of the means indicated that "louder" judgments produced higher mean scores within all age and sex groups than did "softer" judgments.

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Insert Table 12

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The results of the analyses of variance comparisons of JT-LOUDER and JT-SOFTER scores are presented in Tables 13 and 14 respectively. Both analyses revealed no significant interactions between sex and age and no significant differences between the two sex groups on either "louder" or "softer" type judgments.

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Insert Tables 13 - 14

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However, both analyses did disclose significant differences across age groups. Follow-up t-test comparisons of the least squares means for JT-LOUDER data indicated that each successively older age group was significantly more accurate in choosing the louder of the melody pair stimulus: three-year-olds scored significantly lower than both four-year-olds ($p < .0004$) and five-year-olds ($p < .0001$) when "louder" type judgments were required. In addition, the four-year-olds scored significantly lower than the five-year-olds on JT-LOUDER test items ($p < .02$).

Comparison of JT-SOFTER least squares means indicated similar results: three-year-old subjects' scores were significantly lower than those of the four-year-old group ($p < .001$) and the five-year-old group ($p < .0001$) when "softer" type judgments were required. Scores of the two older groups also differed significantly, with the five-year-olds scoring higher than the four-year-olds on JT-SOFTER test items ($p < .03$).

Task Type Analyses

Task Type (i.e., Single Task and Varied Task) least squares means and standard errors (by sex and age groups) are listed in Table 15. An examination of the means revealed that the Single Task produced higher mean scores within all age and sex groups, suggesting that the young

subjects could more accurately discriminate the melody pair stimulus when only one type of judgment and verbal label was required over a series of test items.

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Insert Table 15

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The results of the analysis of variance on Single Task data (see Table 16) revealed no significant interactions or differences between sex groups. An F- ratio of 16.04 ($p < .0001$), however, was found for the main effect of age. T-test comparisons of age group means revealed that accuracy on Single Task discrimination items increased significantly as age increased: significant differences were found between (a) three- and four-year-olds ($p < .0007$), (b) three- and five-year-olds ($p < .0001$), and (c) four- and five-year-olds ($p < .02$).

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Insert Table 16

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Similar results were found on the analysis of variance of Varied Task data (see Table 17). The analysis disclosed a significant F- ratio only for the main effect of Age (F-ratio = 13.51, $p < .0001$). Follow-up comparisons of age group means indicated progressive improvement in discrimination accuracy on Varied Task items across age. Significant differences were found among all age groups, the three-year-olds scoring significantly lower than the four-year-olds ($p < .001$) and the five-year-olds ($p < .0001$) and the four-year-olds scoring significantly lower than the five-year-olds ($p < .04$).

Insert Table 17

## Conclusions

1. No significant interactions between the factors of age and sex were found across any of the loudness discrimination variables investigated.

2. Significant differences associated with age were found in pre-school children's loudness discrimination.

a. Significant differences were found across all age groups in the study, with younger age groups scoring significantly lower on the Loudness Discrimination Test than older age groups.

b. Progressive, significant differences across age were noted for both loud-soft and soft-loud presentation orders of the musical stimulus on the test. Progressive, significant improvement in scores occurred across all three age groups for the loud-soft presentation order. Significant differences between three-year-olds and both of the older age groups were found; however, four- and five-year-olds' scores were not significantly different.

c. On all four intensity levels investigated, three-year-olds scored significantly lower than both older age groups. The four- and five-year-olds differed significantly only on responses involving Medium Range (60-70 db) and Loud Range (70-80 db) intensity levels. The Span Range (55-75 db) proved to be the easiest of the intensity ranges for children to discriminate.

d. In regard to type of judgment required of subjects, "louder" judgments produced higher mean scores within all age groups than did "softer" judgments. Furthermore, each successively older age group was significantly more accurate in choosing the louder of the

melody pair stimulus for both Louder Judgment Type items and Softer Judgment Type items.

e. Age also was found to be a significant factor in the analysis of Task Type data. Accuracy on Single Task discrimination items increased as age increased; similarly, discrimination accuracy of Varied Task items improved progressively with age. The Single Task requirement produced higher mean scores than did the Varied Task.

3. Male and female subjects' loudness discrimination differed significantly only on one variable measured: males scored significantly better than females on items in the loud dynamic range (70-80 db). No other significant differences across sex were noted in the study.

## Discussion

From these results, it appears that the factor of age is a much more influential contributor to differences in loudness discrimination than is the factor of sex. The study results using a musical stimulus rather than single tones or white noise are consistent with findings of other studies. The high test scores of the majority of subjects regardless of age or sex indicate that loudness discrimination is a highly developed skill among preschool-age children and that, by the age of five, children are quite competent in this skill. By the age of five, there seems to be little difficulty with conceptual understanding or vocabulary associated with loudness discrimination tasks. However, the study results indicate that (1) with musical stimuli, loudness discrimination is still in a developmental period between the ages of three and five years and (2) that factors such as presentation order, intensity level, judgment type, and type of task required can influence a young child's loudness discrimination judgments.

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Table 1

Item and Subtest Order for the
Loudness Discrimination Test

| Subtest 1 | Subtest 2 | Subtest 3 |
|---|---|---|
| Which sound is LOUDER? | Which sound is SOFTER? | Which sound is . . . |
| 1. 60 db - 70 db | 1. 50 db - 60 db | 1. SOFTER? 70 db - 80 db |
| 2. 50 db - 60 db | 2. 70 db - 60 db | 2. LOUDER? 55 db - 75 db |
| 3. 70 db - 60 db | 3. 70 db - 80 db | 3. LOUDER? 70 db - 60 db |
| 4. 60 db - 50 db | 4. 60 db - 70 db | 4. SOFTER? 70 db - 60 db |
| 5. 80 db - 70 db | 5. 60 db - 50 db | 5. LOUDER? 50 db - 60 db |
| 6. 70 db - 80 db | 6. 80 db - 70 db | 6. SOFTER? 60 db - 70 db |
| 7. 75 db - 55 db | 7. 75 db - 55 db | 7. SOFTER? 50 db - 60 db |
| 8. 55 db - 75 db | 8. 55 db - 75 db | 8. LOUDER? 75 db - 55 db |
| | | 9. LOUDER? 60 db - 70 db |
| | | 10. SOFTER? 60 db - 50 db |
| | | 11. LOUDER? 70 db - 80 db |
| | | 12. LOUDER? 60 db - 50 db |
| | | 13. SOFTER? 55 db - 75 db |
| | | 14. SOFTER? 75 db - 55 db |
| | | 15. LOUDER? 80 db - 70 db |
| | | 16. SOFTER? 80 db - 70 db |

Table 2

Total Score L-S Means and Standard Errors by Sex and Age Groups

| Group | | N | L-S Mean | Standard Error |
|---|---|---|---|---|
| Sex | M | 45 | 26.96 | 0.64 |
| | F | 47 | 27.19 | 0.62 |
| Age | 3 | 27 | 23.99 | 0.81 |
| | 4 | 34 | 28.08 | 0.72 |
| | 5 | 31 | 30.64 | 0.76 |

Table 3

Least Squares Analysis of Variance Comparisons of Differences Among Groups on Total Test Scores

| Source | df | SS | MS | F | P |
|---|---|---|---|---|---|
| Sex | 1 | 13.12 | 13.12 | 0.76 | .39 N.S. |
| Age | 2 | 617.44 | 308.72 | 17.86 | .0001 |
| Sex * Age | 2 | 57.42 | 28.71 | 1.66 | .20 N.S. |
| Error | 86 | 1486.47 | 17.28 | | |
| Total | 91 | | | | |

Table 4

Presentation Order L-S Mean Scores
And Standard Errors By Sex and Age Groups

| Presentation Order | Group | | N | L-S Mean | Standard Error |
|---|---|---|---|---|---|
| LOUD - SOFT | Sex | M | 45 | 14.15 | 0.42 |
| | | F | 47 | 13.21 | 0.41 |
| | Age | 3 | 27 | 11.64 | 0.54 |
| | | 4 | 34 | 13.89 | 0.48 |
| | | 5 | 31 | 15.51 | 0.51 |
| SOFT - LOUD | Sex | M | 45 | 13.81 | 0.33 |
| | | F | 47 | 13.97 | 0.32 |
| | Age | 3 | 27 | 12.35 | 0.42 |
| | | 4 | 34 | 14.19 | 0.37 |
| | | 5 | 31 | 15.13 | 0.40 |

Table 5

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Loud-Soft Presentation Order Scores

| Source | df | SS | MS | F | P |
|---|---|---|---|---|---|
| Sex | 1 | 19.35 | 19.35 | 2.52 | .12 N.S. |
| Age | 2 | 207.63 | 103.82 | 13.51 | .0001 |
| Sex * Age | 2 | 16.68 | 8.34 | 1.09 | .34 N.S. |
| Error | 86 | 660.89 | 7.68 | | |
| Total | 91 | | | | |

Table 6

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Soft-Loud Presentation Order Scores

| Source | df | SS | MS | F | p |
|---|---|---|---|---|---|
| Sex | 1 | 0.60 | 0.60 | 0.13 | .72 N.S. |
| Age | 2 | 109.65 | 54.83 | 11.60 | .0001 |
| Sex * Age | 2 | 16.68 | 8.34 | 1.76 | .18 N.S. |
| Error | 86 | 406.39 | 4.73 | | |
| Total | 91 | | | | |

Table 7

Intensity Level L-S Mean Scores And Standard Errors by Sex and Age Groups

| Intensity Level | Group | | N | L-S Mean | Standard Error |
|---|---|---|---|---|---|
| Soft Range (50-60 db) | Sex | M | 45 | 6.53 | 0.20 |
| | | F | 47 | 6.49 | 0.20 |
| | Age | 3 | 27 | 5.67 | 0.26 |
| | | 4 | 34 | 6.63 | 0.22 |
| | | 5 | 31 | 7.23 | 0.24 |
| Medium Range (60-70 db) | Sex | M | 45 | 6.72 | 0.20 |
| | | F | 47 | 6.86 | 0.19 |
| | Age | 3 | 27 | 5.80 | 0.25 |
| | | 4 | 34 | 6.89 | 0.22 |
| | | 5 | 31 | 7.68 | 0.24 |
| Loud Range (70-80 db) | Sex | M | 45 | 7.27 | 0.18 |
| | | F | 47 | 6.75 | 0.18 |
| | Age | 3 | 27 | 6.08 | 0.24 |
| | | 4 | 34 | 7.15 | 0.21 |
| | | 5 | 31 | 7.81 | 0.22 |
| Range Span (55-75 db) | Sex | M | 45 | 7.44 | 0.17 |
| | | F | 47 | 7.08 | 0.17 |
| | Age | 3 | 27 | 6.44 | 0.22 |
| | | 4 | 34 | 7.42 | 0.20 |
| | | 5 | 31 | 7.92 | 0.21 |

Table 8

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Soft Range Intensity Level Scores

| Source | df | SS | MS | F | p |
|---|---|---|---|---|---|
| Sex | 1 | 0.03 | 0.03 | 0.02 | .89 N.S. |
| Age | 2 | 33.86 | 16.93 | 9.63 | .0002 |
| Sex * Age | 2 | 2.33 | 1.17 | 0.66 | .51 N.S. |
| Error | 86 | 151.15 | 1.76 | | |
| Total | 91 | | | | |

Table 9

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Medium Range Intensity Level Scores

| Source | df | SS | MS | F | p |
|---|---|---|---|---|---|
| Sex | 1 | 0.40 | 0.40 | 0.24 | .63 N.S. |
| Age | 2 | 49.13 | 24.57 | 14.61 | .0001 |
| Sex * Age | 2 | 1.32 | 0.66 | 0.39 | .68 N.S. |
| Error | 86 | 144.63 | 1.68 | | |
| Total | 91 | | | | |

Table 10

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Loud Range Intensity Level Scores

| Source | df | SS | MS | F | p |
|---|---|---|---|---|---|
| Sex | 1 | 5.85 | 5.85 | 4.06 | .05 |
| Age | 2 | 41.58 | 20.79 | 14.42 | .0001 |
| Sex * Age | 2 | 6.69 | 3.34 | 2.32 | .10 N.S. |
| Error | 86 | 123.99 | 1.44 | | |
| Total | 91 | | | | |

Table 11

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Span of Intensity Level Scores

| Source | df | SS | MS | F | p |
|---|---|---|---|---|---|
| Sex | 1 | 2.78 | 2.78 | 2.16 | .15 N.S. |
| Age | 2 | 31.21 | 15.61 | 12.15 | .0001 |
| Sex * Age | 2 | 6.32 | 3.16 | 2.46 | .09 N.S. |
| Error | 86 | 110.43 | 1.28 | | |
| Total | 91 | | | | |

Table 12

Judgment Type L-S Mean Scores and
Standard Errors By Sex and Age Groups

| Judgment Type | Group | | N | L-S Mean | Standard Error |
|---|---|---|---|---|---|
| "Louder" | Sex | M | 45 | 14.11 | 0.30 |
| | | F | 47 | 13.73 | 0.30 |
| | Age | 3 | 27 | 12.30 | 0.38 |
| | | 4 | 34 | 14.15 | 0.34 |
| | | 5 | 31 | 15.32 | 0.36 |
| "Softer" | Sex | M | 45 | 13.84 | 0.38 |
| | | F | 47 | 13.45 | 0.37 |
| | Age | 3 | 27 | 11.70 | 0.49 |
| | | 4 | 34 | 13.93 | 0.43 |
| | | 5 | 31 | 15.31 | 0.46 |

Table 13

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Louder Judgment Type Scores

| Source | df | SS | MS | F | p |
|---|---|---|---|---|---|
| Sex | 1 | 3.17 | 3.17 | 0.84 | .36 N.S. |
| Age | 2 | 128.13 | 64.07 | 16.95 | .0001 |
| Sex * Age | 2 | 16.13 | 8.07 | 2.13 | .12 N.S. |
| Error | 86 | 325.04 | 3.78 | | |
| Total | 91 | | | | |

Table 14

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Softer Judgment Type Scores

| Source | df | SS | MS | F | p |
|---|---|---|---|---|---|
| Sex | 1 | 3.39 | 3.39 | 0.54 | .46 N.S. |
| Age | 2 | 183.03 | 91.52 | 14.59 | .0001 |
| Sex * Age | 2 | 13.10 | 6.55 | 1.04 | .35 N.S. |
| Error | 86 | 539.47 | 6.27 | | |
| Total | 91 | | | | |

Table 15

Task Type L-S Mean Scores and
Standard Errors by Sex and Age Groups

| Type of Task | Group | | N | L-S Mean | Standard Error |
|---|---|---|---|---|---|
| Single Task | Sex | M | 45 | 14.15 | 0.36 |
| | | F | 47 | 13.82 | 0.35 |
| | Age | 3 | 27 | 12.09 | 0.46 |
| | | 4 | 34 | 14.23 | 0.40 |
| | | 5 | 31 | 15.64 | 0.43 |
| Varied Task | Sex | M | 45 | 13.78 | 0.34 |
| | | F | 47 | 13.36 | 0.33 |
| | Age | 3 | 27 | 11.90 | 0.44 |
| | | 4 | 34 | 13.82 | 0.39 |
| | | 5 | 31 | 15.00 | 0.41 |

Table 16

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Single Task Scores

| Source | df | SS | MS | F | p |
|---|---|---|---|---|---|
| Sex | 1 | 2.43 | 2.43 | 0.44 | .51 N.S. |
| Age | 2 | 175.04 | 87.52 | 16.04 | .0001 |
| Sex * Age | 2 | 23.52 | 11.76 | 2.16 | .12 N.S. |
| Error | 86 | 469.09 | 5.45 | | |
| Total | 91 | | | | |

Table 17

Least Squares Analysis of Variance
Comparisons of Differences Among Groups
On Varied Task Scores

| Source | df | SS | MS | F | p |
|---|---|---|---|---|---|
| Sex | 1 | 3.84 | 3.84 | 0.77 | .38 N.S. |
| Age | 2 | 134.66 | 67.33 | 13.51 | .0001 |
| Sex * Age | 2 | 8.01 | 4.01 | 0.81 | .45 N.S. |
| Error | 86 | 428.65 | 4.98 | | |
| Total | 91 | | | | |